

# Disease Control in the Vegetable Garden

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CLUB-ROOT OF CABBAGE

EVERY gardener should rotate his vegetable plots, for nearly one-third of all vegetable-disease control is accomplished by using no beds or fields where the same or related crops were planted the previous year. In practicing rotations, the gardener should remember that families of vegetables are subject to the same diseases and that they should

not follow one another. Melons, cucumbers, squashes, and all other vine crops should be on the other side of the garden or in another field from where they were the preceding season. The same holds true for the cabbage-cauliflower-brussels-sprouts-broccoli group, and for the potato-tomato-eggplant-pepper family. The first rule, then, in successful gardening is

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to rotate not merely by individual crops but by plant families.

The second major offensive in disease warfare is the destruction of weeds both in the garden and near it. On a farm with large fields, this is comparatively easy; in small gardens, the weeds may be on neighboring property over which the gardener has no control. Every effort should be made to eradicate weeds, especially those belonging to the mustard family, milkweeds, nightshade, ground-cherry or husk tomatoes, bur or wild cucumber, catnip, and mother-wort. Where it is impossible to keep the weeds out by cultivation, the dangerous ones may be eliminated by frequent mowing with a lawn mower. Even flowers may sometimes be a menace. Each year some petunias are the source of the mosaic virus which dwarfs tomato seedlings and destroys melons and cucumbers.

In addition to rotation and weed eradication, other important steps in disease control include: good soil drainage, proper tillage, sufficient fertilizer, destruction of diseased plant refuse, healthy seed (certified if possible), a clean seedbed, and the use of young plants from reliable sources. Usually it is an advantage to buy plants locally so that the conditions under which they are grown will be known.

Seed treatments and spraying or dusting are discussed under the individual crops.

### THE CABBAGE FAMILY

Cabbage, cauliflower, broccoli, brussels sprouts, Chinese cabbage, turnip, and the like

**Club-root.** Drainage, destruction of mustard weeds, clean seedbeds, and long rotations are important. In the seedbed, the young plants can be protected by from 2 to 4 applications of a corrosive-sublimate (bichloride) solution poured along the row, being careful not to wet the leaves. One ounce of the powder is dissolved in hot water, and then diluted to 15 gallons, or in that proportion. One pint of this solution will treat from 3 to 5 feet of

seedling row, depending upon the size of the plants. Only glass or wooden containers should be used to hold the liquid. In the field, the application of hydrated lime sufficient to make the soil slightly neutral controls the disease. The county agricultural agent upon request will test the soil for alkalinity. Club root may be controlled on cabbage also by pouring  $\frac{1}{2}$  pint of the bichloride solution into the hole when the plant is being set. This solution injures cauliflower or broccoli.

**Black-rot, black-leg, peppery leaf spot, mildew, and Alternaria blight.** In addition to the general recommendations on page 1, seed treatment is necessary. Most seeds of the cabbage family can be bought already treated with hot water. In some counties the agricultural agent has facilities for making the treatment. It must be done carefully or seed injury will result. The home gardener may make the treatment if he has a thermometer accurate at 122° F. Most house thermometers, although reliable at 70° F, may vary too much at higher temperatures. A wash boiler or tub is fitted with a false wooden bottom, and filled with hot water at 122° F. (50° C.). The seed is tied loosely in cheesecloth (never more than 2 pounds in 1 bag) and placed in this water. The very edge of the boiler may be over a low flame, so that the temperature is kept exactly at 122° F. Cabbage is treated for 25 minutes, and all the other crucifers for from 15 to 18

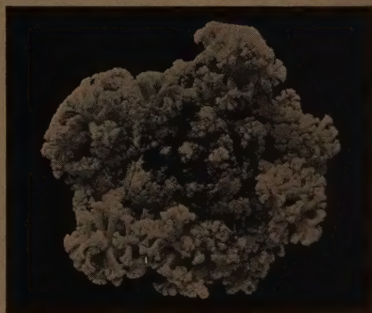


FIGURE 1. ALTERNARIA BLIGHT  
ON CAULIFLOWER

minutes, then the seed is removed and dried thoroughly. Just before it is planted, the seed should be treated with Semesan dust or zinc oxide (1 ounce in 15 pounds or just enough to cover each seed slightly). The seed can be placed in a fruit jar, or some other container, with the dust, and shaken for a few minutes. This dusting is desirable especially if the seed has been treated with hot water.

**Damping-off and wire-stem.** Seed treatment, as described in the preceding paragraph, and, after the plants are up, an application of a corrosive-sublimate solution as suggested for club root (page 2) will protect the seedlings while they are in the seedbeds. If mercury products, such as corrosive sublimate are difficult to procure, small beds may be protected by a zinc-oxide dust applied over the soil. It must touch the base of each stem. A large salt shaker makes a convenient applicator. Enough dust is applied to keep the surface of the soil fairly white. It may be applied just as the plants are breaking through the soil, and additional applications made to keep the surface covered if any part of the bed has been stirred. Copper compounds should not be used on cabbage seed or in cabbage seedbeds.

**Cabbage yellows (*Fusarium* wilt).** The only control for cabbage yellows is to plant resistant varieties. As long as yellows is not present the old cabbage varieties are preferable; but as soon as the disease appears, only resistant strains should be planted. Such seed can be bought from any reliable seed house. Among the varieties now on the market are Resistant Golden Acre, Jersey Queen, Detroit Resistant, Racine Market, Wisconsin Allhead Select, Marion Market, Wisconsin All Seasons, Globe, Wisconsin Ballhead, and Wisconsin Hollander No. 8. These include the Jersey Wakefield, early and late Copenhagens, kraut, and storage types.

#### The Vine Family

Cucumber, muskmelon, squash,  
pumpkin, watermelon

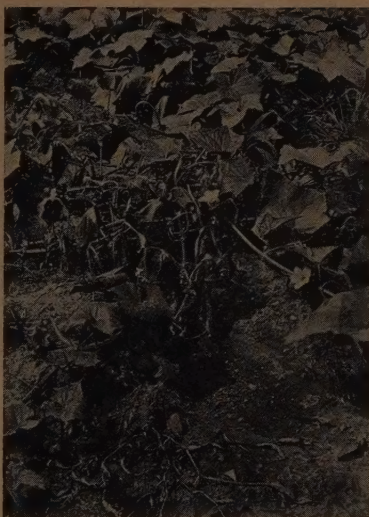


FIGURE 2. BACTERIAL WILT ON CUCUMBERS

**Bacterial wilt; downy mildew, and powdery mildew.** The spray or dust applications should be begun as soon as the plants are through the ground, and should be repeated within 3 or 4 days and thereafter every week as long as the plants require protection. Because the wilt bacteria live over winter within the striped and spotted cucumber beetles, and also are disseminated by them, the spray or dust should include an insecticide. The very small plants can be dusted more easily than sprayed. When they are larger, spraying may be desirable. A hand duster of the bellows type is a satisfactory applicator. Lime or wood ashes, especially in hot dry weather, tend to dwarf the plants. Consequently, dusts and sprays without these ingredients now are on the market. A cucumber or melon dust containing about 5 per cent of copper (any one of several low-soluble copper compounds now available), 1 per cent of rotenone or 10 per cent of calcium arsenate, 10 per cent of flour, and the remainder of talc is sold by dealers handling such products, and will protect the vine crops from the diseases

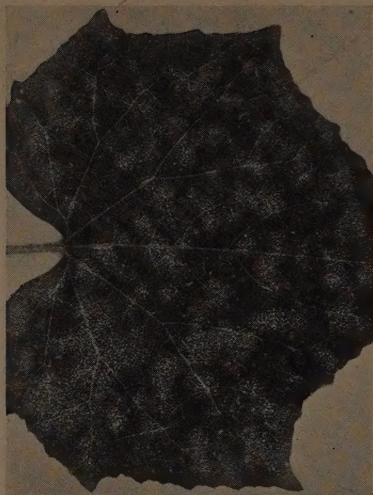


FIGURE 3. POWDERY MILDEW ON  
MELON LEAF

and the insects that may carry disease organisms.

A spray, if desired, may be prepared by mixing one of the low-soluble copper compounds with rotenone or calcium arsenate.<sup>1</sup> If yellow oxide is used, 1 pound in 100 gallons is sufficient; red oxide, 2.5 pounds; oxychloride, oxychloride sulfate, or tri-basic, 4 pounds are required in 100 gallons of spray, or in that proportion (about 3 ounces in 2 gallons). Any sprayer that produces a fine mist is satisfactory. All parts of the plant should be covered with a spray film, but large drops of spray should not be permitted on the foliage.

If only bacterial wilt is to be combated and there are only a few plants, they may be protected by a cheesecloth covering tightly stretched over wooden barrel hoops or some other support.

**Anthraxnose, scab, and blight.** In addition to spraying or dusting, the seed should be treated with corrosive sublimate (bichloride), 1 tablet of about 8 grains in each pint of water, or 1 ounce of the powder in 7.5 gallons of water. The

powder first must be dissolved in hot water. Glass or wooden containers are required for all mercury solutions. The volume of solution should be three times more than the volume of seed to be treated. The seed is dipped in the poison for 5 minutes, then rinsed thoroughly in clean water, and dried. Just before it is planted, it should be treated with a dust to control seed rot and damping-off. Red copper oxide, Spergon, or Semesan, at the rate of about  $\frac{1}{2}$  teaspoonful to each pound of seed, or just enough to cover each seed lightly, is recommended. These products are handled by most dealers of fungicides or by seedsmen. The seed and the dust may be placed into any tight container and shaken for a few minutes.

**Mosaic.** Spraying or seed treatment does not control mosaic. The plants that carry the virus over winter in their seeds or perennial roots must be eradicated for at least 150 feet from all vine crops. These weeds are here listed somewhat in the order of their importance in transmitting the virus: catnip, mother-wort, bur cucumber, petunia, milkweed, poke berry, ground-cherry, and nightshade. On Long Island the poke berry or soko is the chief offender. Eradication by pulling or occasional mowing is not effective, for shoots



FIGURE 4. CUCUMBER ANTHRACNOSE  
ON MELON

<sup>1</sup>Insect control in the vegetable garden. By R. W. Leiby. Cornell Ext. Bul. 503:7. 1942.

grow from the roots left in the soil and the amount of virus in these young leaves is always abundant. The place where the weeds occurred may be planted to some cultivated crop. If that is not feasible, the area may be treated as a lawn and mowed repeatedly. This destroys all the dangerous weeds. Or, if convenient and free from danger of poisoning children or cattle, crystals of sodium chlorate or some other weed eradicator may be applied to the area the autumn before the vine crops are to be planted.

### Tomato

**Bacterial canker, Septoria blight, early blight, and bacterial spot.** Seed treatments, seedbed spraying, and at least a 2-year rotation of crops are recommended strongly. Spraying after the plants are large also is suggested if the grower has the proper spraying apparatus. The hot-water seed treatment is exactly like that suggested for cabbage (page 2). The temperature and time are 122° F. for 25 minutes. While the seeds are still wet they may be dipped in a blue-vitriol solution (2 ounces dissolved in 1 gallon of water) for an hour, then removed and dried carefully. After the hot-water seed treatment, some gardeners may find it convenient to dry the seed immediately, then, just before planting, to dust it with red copper oxide or Spergon, 1 level teaspoonful for each pound of seed, or enough to cover each seed lightly with the dust. The dust has not proved so effective as the blue-vitriol solution.

As soon as the plants are up in the seedbed they should be sprayed with one of the low-soluble copper compounds (page 4). Lime is injurious to young tomato plants, so that bordeaux mixture is not recommended. A hand sprayer may be used, but a group of greenhouse growers may buy cooperatively a small power sprayer, which is narrow enough to draw through the aisles of a greenhouse and does an excellent job of spraying. The spray should cover all parts of the plant, especially the base and the soil about it. The applications

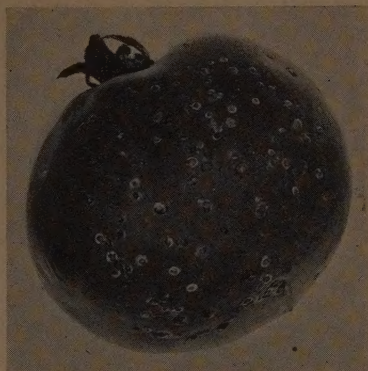


FIGURE 5. BACTERIAL CANKER ON TOMATO

should be made at 4- to 7-day intervals until the plants are ready to set into the field. If a power sprayer is used, the pressure should be no greater than 250 pounds as indicated on the dial.

The growers may wish to spray after the plants are set into the field. The first application there is made when the plants have grown enough foliage to be bushy or just before the vines fall over. The same sprays are used as for plants in the seedbed, except for the amount of the yellow oxide, 1.5 pounds in 100 gallons of water. From 2 to 3 additional applications are made at about 10-day intervals. The lower and inner part of the plants require most of the spray.

Seed treatment, seedbed spraying, proper rotation, and a few side dressings of nitrogen fertilizer, beginning when the first fruit shows and repeating after 10 days or after any heavy leaching rains, has given some blight and canker control without further field spraying.

**Blossom end rot.** Sufficient water must be available for the plants at all times. An abundant supply of well-decayed humus in the soil insures a more uniform moisture content for the roots. If in hot dry weather the plants in the garden are protected from drying winds, either by a wind-break or a cloth shade, drouth injury is reduced. Sometimes a slight mist of spray from a

hose during an especially strong dry wind will reduce blossom end rot. A liberal application of superphosphate before planting time also is of assistance. Loose gravel-

ly soils, unrotted leaves or grass spaded under, or any other practice that hinders the plant from taking up water through the roots as fast as the leaves give it off into dry air should be avoided.

**Mosaic.** The only way to control mosaic is to eradicate all weeds in the vicinity of greenhouses or hot beds. The most important weeds and the methods of eradicating them are given on page 2. Because the virus can live in natural leaf chewing tobacco and in cigarette butts, no one should use tobacco while working with tomato seedlings, and he should wash his hands in soap and water after handling tobacco or other infected plants.

#### Snap Beans and Lima Beans

**Anthraxnose and bacterial blights.** Bean seed certified as being grown in the Marysville district of California or the Twin Falls area of Idaho is free from anthracnose and bacterial blight, and, if planted where no beans have been grown for at least a year, these two severe diseases can be prevented. The commonly grown Bountiful and Black Wax varieties are most susceptible to blight, but the Tendergreen shows considerable resistance. The U. S. No. 5 Refugee may have much blight, while the older strains of Refugee remain almost free from the disease. By careful buying, either of certified Western seed or procuring resistant

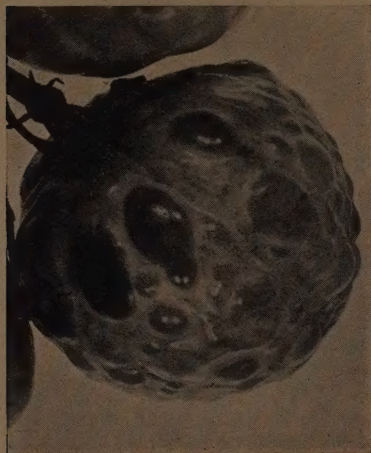


FIGURE 6. MOSAIC ON TOMATO FRUIT

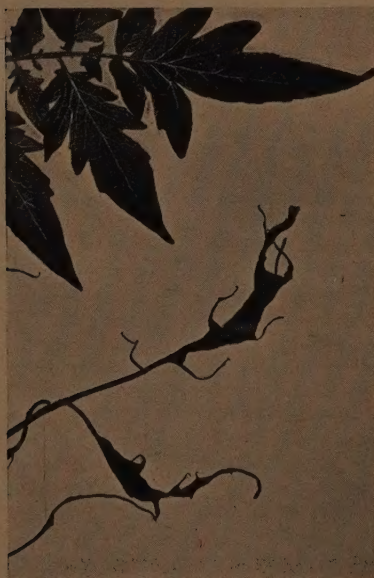


FIGURE 7. CUCUMBER MOSAIC ON TOMATO



FIGURE 8. BEAN ANTHRACNOSE

strains, beans can be grown successfully.

If blight or anthracnose has once appeared in a planting, the bushes should not be touched when they are wet, for the bacteria and fungous spores are then liberated from their gelatinous capsules and are free to be disseminated in every direction.

**Mosaic.** The older strains of Refugee and pea beans, as well as the newer selection, Michelite, are susceptible to mosaic. If Refugees are to be grown, U. S. No. 5 produced in the Twin Falls, Idaho, region should be planted. So far as mosaic is concerned most of the other snap beans are resistant enough so that they can be grown if bacterial blight is controlled.

**Dry root rot.** When the dry root rot once gets into a garden, the only remedy is to cease growing beans for at least 5



FIGURE 10. BEAN MOSAIC ON YOUNG LEAF



FIGURE 9. BACTERIAL BLIGHT OF BEAN

years, or to sterilize the soil.<sup>2</sup> Beans that are kept in excellent growing conditions by tilth and proper fertilizing will in part outgrow the trouble. Care should be exercised to keep all bean refuse from the garden or field where the crop may be grown. Yellow-eye and Refugee are the most susceptible varieties, and should not be planted if there is danger of root rot. Seed treatment or spraying is of no value in controlling the disease.

**Downy mildew, bacterial spot, and pod blight of lima beans.** Western-grown seed, crop rotation, and well-drained soil should be accompanied by spraying or dusting to control downy mildew, bacterial spot, and pod blight. The same sprays or dusts suggested for cucumbers (page 3) are effective on lima beans. An insecticide may be added if insects are present. The number of applications will depend upon the wetness of the season. In very dry weather, no spray is required. If there are long drizzling rains or frequent fogs, the first spray or dust should be put on when the plants have made enough growth to retain moisture in the foliage. Additional

<sup>2</sup>Soil treatment for the control of diseases in the greenhouse and the seedbed. By A. G. Newhall, Charles Chupp, and C. E. F. Guterman. Cornell Ext. Bul. 217. Revised 1942.

applications are made at 10-day intervals as long as there is danger of infection. All parts of the plants should be covered with a film of liquid or dust but not with big drops nor clumps.

### Peas

Nearly all pea seed now is grown in the areas of the West where pea diseases are not prevalent. But it still is necessary to treat the seed with some dust to prevent excessive seed rotting. Spergon, red copper oxide, or Semesan, 1.5 to 2.5 ounces for each bushel ( $\frac{1}{2}$  teaspoonful for each pound) or enough to cover each seed lightly, are the recommended dusts. A mixer is required for large quantities of seed, but in pound-lots it can be placed in any tight container and shaken thoroughly with the dust for 2 minutes.

To prevent root rot, long rotations of crops are required, and sufficient fertilizer should be applied to peas to maintain rapid growth and development. Clover mosaics may be transmitted to peas; therefore, it is well not to grow them near other legume crops, especially white clover.

### Spinach

All spinach seed should be treated with zinc oxide, red copper oxide, or Spergon in the same manner as suggested for tomatoes (page 5). If downy mildew or blue-mold has been prevalent, no winter spinach should be grown in the same community where spring spinach is planted. The only way to control mosaic or yellows is to grow a resistant variety, such as Virginia Savoy or Old Dominion. The yellows is likely to be severe only on the late-summer crop.

### Celery

Celery can rarely be grown without serious losses from the various blights unless the plants, both in the seedbed and in the field, are sprayed or dusted once a week. Bordeaux mixture made by dissolving 1 pound of blue vitriol in  $12\frac{1}{2}$  gallons of water, stirring 1 pound of fresh hydrated lime in another  $12\frac{1}{2}$  gallons, and



FIGURE 11. EARLY BLIGHT OF CELERY

then pouring these two materials together (stirring vigorously during the mixing), is still the preferred spray for celery. If dust is desired, either copper-lime dust, 20-80, or one of the low-soluble copper dusts may be used. All of these are now on the market ready mixed.

### Onions

If downy mildew destroys the onions, all Top-Set onions, which carry the mildew over winter, should be destroyed. The winter and spring or summer types of onions usually cannot be grown near each other.

### Sweet Corn

If sweet corn is planted very early while the soil is cold and wet, the seed should be dusted with New Improved Ceresan Jr. or Spergon,  $1\frac{1}{2}$  to 2 ounces for each bushel, or  $\frac{1}{2}$  teaspoonful for each pound. Recent work has shown that seed treatment may increase the yield even of late-planted corn.